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(54) Fuel-storing device

(57) The invention relates to a device for storing fuel in an engine-powered transport means (1; 1'), comprising at least one closed construction element (4, 5, 6, 7; 11) which is incorporated as an integral part of the body or chassis structure (3; 3') of the transport means (1; 1'). The invention is characterized in that the said closed construction element (4, 5, 6, 7; 11), moreover, is arranged as a storage unit for the said fuel. As a result of the invention, an improved fuel storage unit is provided for, in particular, hydrogen-gas-powered motor vehicles.

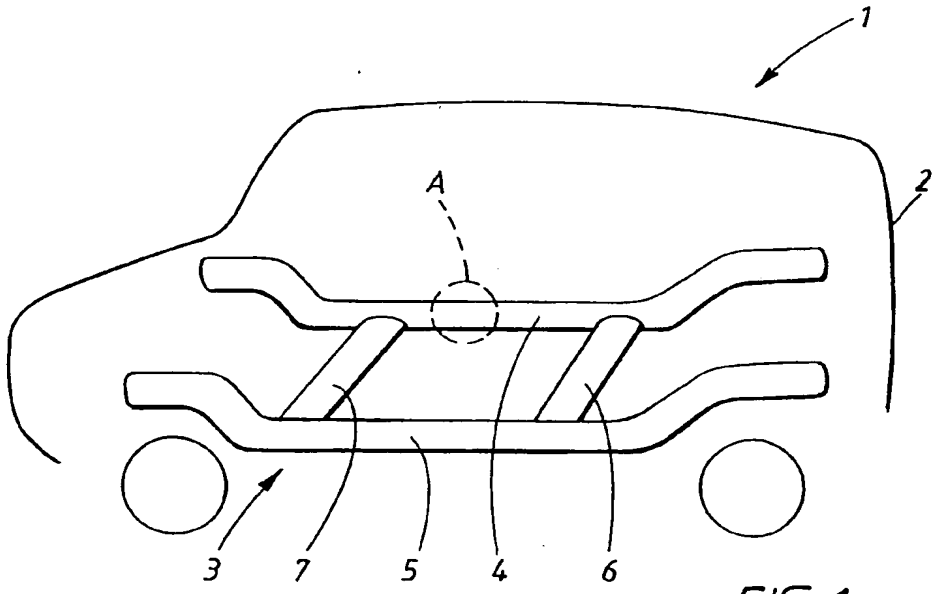

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a fuel-storing device, according to the preamble to subsequent claim 1. The invention is intended to be used for storing gaseous fuels for transport means, expediently in the form of motor vehicles such as, for example, passenger cars. The invention also relates to a transport means comprising such a device, according to subsequent claim 8.

PRIOR ART

[0002] In connection with engine-powered transport means, for example cars, aeroplanes and rockets, there is a general requirement for safe, effective and economical storage of engine fuel.

[0003] As far as combustion-engine-powered vehicles are concerned, for example in the form of passenger cars, it has in recent years become increasingly desirable to use engines which are powered with alternative types of fuel compared with those used in current conventional petrol and diesel-powered engines. As an example can be cited engines which are powered by natural gas, alcohol-based fuels (methanol or ethanol) or hydrogen gas. The reason for the adoption of new fuels is partly that the earth's reserves of fossil fuels are thought to be limited and also the growing public opinion and increasingly tough legislation in favour of environmentally friendly engine fuels and vehicles.

[0004] In this context, it has been established that hydrogen gas can be used as fuel for engine-powered vehicles and that an engine system of this kind then represents a suitable alternative to a conventional petrol-powered or diesel-powered combustion engine. The reason why hydrogen gas is suitable as fuel is primarily that it can be produced using, for example, solar energy. Moreover, hydrogen gas is burnt without carbon dioxide (CO_2) being generated, which is an advantage, since generation of carbon dioxide (for example through burning of fossil fuels) is thought to contribute to the so-called greenhouse effect.

[0005] Where hydrogen is used as fuel in connection with motor vehicles, there are certain problems, above all concerning the difficulty of achieving a storage system on board a vehicle which works in practice. According to the prior art, various types of containers for hydrogen are used in vehicles which is then stored either in gaseous form, in liquid form, bound in metal hydrides or absorbed in carbon.

[0006] Where hydrogen is stored in gaseous form, according to the prior art, a very high storage pressure is required, more precisely a pressure which is of the order of magnitude of 300 bar. This means a relatively high weight and cubic capacity for the storage tanks which are used. Moreover, such a system constitutes a safety risk in connection with, for example, passenger cars.

[0007] When hydrogen is stored in liquid form, a very low temperature is required to be maintained during storage. This calls for costly cooling systems, which is a disadvantage. An advantage of storing hydrogen in liquid form is however that the vehicle in question acquires a relatively long range of travel.

[0008] When hydrogen is stored in a metal hydride system, in which the hydrogen molecules are bound in a metal hydride structure and are released upon heating, a storage system is also required which is relatively heavy. In addition, devices are required for heating the said metal hydride structure to enable the hydrogen thereby to be liberated.

[0009] When hydrogen absorbed in carbon is stored, a very low storage temperature is required for the hydrogen to enable it to be bound to carbon. According to what has been stated above, this is a disadvantage.

[0010] It can further be established that previously known systems which are based on hydrogen-powered fuel cells lead to difficulties in connection with tubings, connections to and distribution within the fuel cells, which difficulties are hard to solve from the leakage, flow, collision and safety aspects. Moreover, previously known hydrogen gas containers have been space-consuming, expensive, temperature-sensitive or heavy and difficult to place in the vehicle in question.

[0011] In patent document US 5653951, a system is described for storing hydrogen gas in so-called nanostructures, i.e. microstructures which are constructed as a matrix of graphite laminae having dimensions which are tailored to the acceptance of hydrogen molecules. Nanostructures of this kind can be used to store a large quantity of hydrogen gas per unit of volume compared with previously known storage systems. This means that a fuel-cell-powered vehicle having a hydrogen gas tank which has a cubic capacity of, for example, 40 litres and comprises nanostructures acquires a range of travel of just over 12 800 km.

[0012] By virtue of document DE 19708404, a vehicle chassis having a special fuel-storage space accommodated in the lower section of the chassis is also previously known. More precisely, this fuel storage space is constituted by a defined space adjoining the floor of the vehicle. In the fuel-storage space, a number of different types of energy carriers can be arranged and used, the energy carriers being installed in this case from the side of the vehicle. In the DE-document, a hydrogen gas container is cited as a conceivable energy-storage method. The arrangement according to the DE-document is set up as an exchangeable system, i.e. a fuel-storage system which is configured such that its various fuel containers can easily be reached and individually exchanged, instead of being filled at regular intervals.

[0013] In the light of the above, it can be seen that there is a need for storage systems for hydrogen which are more cost-effective, economical, safe, lightweight, easy to handle and more compact than previously known storage systems.

DISCLOSURE OF THE INVENTION

[0014] The object of the present invention is to provide an improved device for storing engine fuel, more especially hydrogen, in transport means, in which the abovementioned problems can effectively be solved. This is achieved by means of a device, the distinguishing features of which can be derived from subsequent claim 1.

[0015] The invention constitutes a device for storing fuel in an engine-powered transport means, comprising at least one closed construction element which is incorporated as an integral part of the body or chassis structure of the transport means. The invention is characterized in that the said closed construction element, moreover, is arranged as a storage unit for the said fuel.

[0016] As a result of the invention, a number of advantages are attained. First and foremost, it can be noted that the invention allows safe and effective storage of hydrogen gas in a transport means. According to a preferred embodiment, existing structures in the transport means are configured, moreover, with a nanostructure, for example nanofibres of carbon, which offers the facility for storing hydrogen gas with a very high packing efficiency. This allows, in turn, a high range of travel for the transport means.

[0017] Preferably, according to the invention, use is made of a nanostructure of this kind integrated within a chassis structure belonging to the transport means or within some other exterior or interior construction element, for example panels, doors, hatches or a floor structure of the transport means.

[0018] The invention further allows hydrogen gas to be stored in more safely and economically than is the case with known systems. The fact moreover that the invention uses existing structures in a transport means signifies, moreover, that no increased weight is obtained, which would otherwise follow if a separate tank were used for the fuel.

[0019] According to a preferred embodiment, a barrier layer of metal hydride is used in the abovementioned construction element. In this way, a totally leak-proof storage of the fuel in question is provided.

[0020] Advantageous embodiments of the invention can be derived from the subsequent dependent claims.

DESCRIPTION OF THE FIGURES

[0021] The invention will be explained in greater detail below with reference to a preferred illustrative embodiment and the appended figures, in which:

Figure 1 shows in basic representation an arrangement according to the present invention, based on a first embodiment,

Figure 2 shows an enlargement of a portion of a beam structure which is used according to the invention,

Figure 3 shows in basic representation an arrangement according to the invention, based on a second embodiment, and

Figure 4 shows an enlargement of a portion of a floor panel structure which is used according to the invention.

PREFERRED EMBODIMENTS

[0022] Figure 1 shows in schematic form an arrangement according to the present invention. According to a preferred embodiment, the invention is arranged in a transport means in the form of a motor vehicle 1, more precisely a passenger car. The invention is not however limited to this type of transport means but can in principle be used in all types of engine-powered transport means, for example commercial vehicles, buses, aeroplanes, boats and rockets.

[0023] The vehicle 1 is conventionally constructed with an outer body 2 and a chassis structure 3, which together are configured to give the vehicle 1 its required stability, rigidity and energy-absorbing capability. The chassis structure 3 is, in turn, constructed from a number of closed, i.e. hollow, construction elements in the form of beams, which together form a system of beams involving two longitudinal side beams 4, 5 connected by means of two transverse beams 6, 7.

[0024] The figure is greatly simplified and does not show all of the chassis and body components which are incorporated in the vehicle 1. Various chassis structure arrangements, in the form of beam systems for transport means, are known per se, moreover, and are not described in detail here. Apart from the chassis structure 3, the vehicle 1 additionally comprises, in a known manner, a number of further construction elements, for example, door, floor and roof panels bonnet and boot. Such construction elements are not however shown in Figure 1. The vehicle 1 further comprises traditional vehicle components such as engine, wheel suspension, engine control system, etc. (not shown).

[0025] The beams 4, 5, 6, 7 according to Figure 1 can be configured in various ways. They are preferably produced by so-called hydroforming of aluminium. Hydroforming is a method which is known per se, in which water pressure is used in the forming of the respective beam. Aluminium is suitable for use, since it is a material offering favourable properties with regards weight, rigidity and deformation. Alternatively, magnesium can be used for this purpose. The invention is not however limited to these two materials, nor to being realized by hydroforming, but rather the beams 4, 5, 6, 7 can be made from other materials and by means of other production methods. For example, the beams 4, 5, 6, 7 can be made of steel or fibre-reinforced plastic.

[0026] An underlying principle of the invention is that the beams 4, 5, 6, 7 are of closed configuration and that the closed space which is formed inside the respective beam 4, 5, 6, 7 is used as storage space for a fuel supplying the engine of the vehicle 1. In this context, the

engine fuel is preferably constituted of gaseous hydrogen, which is then used as fuel in a drive device for the vehicle 1. The drive device is expediently based upon hydrogen-gas-powered fuel cells which are known per se. It can thus be said that the beams 4, 5, 6, 7 according to the invention constitute a combined beam system and fuel-storage unit.

[0027] Figure 2 shows a somewhat enlarged view of a portion of a side beam 4, according to the area marked with a dashed circle and having the reference notation A in Figure 1. In principle, all beams 4, 5, 6, 7 are of corresponding configuration.

[0028] As can be seen from Figure 2, the beam 4 is configured with a essentially rectangular cross section with somewhat rounded corners. The invention is not however limited to this configuration, but rather the beam 4 can, in principle, be configured differently, for example with a circular cross section.

[0029] For effective storage of the fuel in question, the beam 4 is preferably configured with an inner structure 8 in the form of a nanostructure, preferably in the form of graphite nanofibres. Nanostructures of this kind, for storing hydrogen, are previously known per se by virtue of American patent US 5653951. The nanostructure allows chemisorption (chemical adsorption) of hydrogen gas molecules, i.e. it is configured with a special crystal structure having lamella-like spaces which are dimensioned in such a way in relation to the size of the molecule that the said chemisorption is admitted. In this way, a strong chemical bonding is obtained between the hydrogen molecules which are adsorbed and the surface in the nanostructure to which they are adsorbed. The construction of the nanostructure, moreover, allows the hydrogen molecules to be packed very tightly.

[0030] As can be seen from Figure 2, the nanostructure 8 is preferably arranged so that it fills essentially the entire hollow space which is formed inside the closed beam 4.

[0031] As can further be seen from Figure 2, the nanostructure 8 is surrounded by a further layer in the form of a barrier layer 9, which is intended to prevent hydrogen gas from leaking out of the beam 4, i.e. through its shell surface. It can be noted in this context that there is a need to ensure that the fuel storage unit which is formed by the beams 4, 5, 6, 7 is totally leak-proof. The barrier layer 9 is preferably constituted by a suitable metal hydride compound by means of which the necessary sealing function can be obtained. The barrier layer 9 is enclosed, in turn, by the casing 10 enclosing the beam 4.

[0032] A plurality of different metal hydride compounds can be used to produce the barrier layer 9. Bound hydrogen in the barrier layer 9 will thereby prevent free hydrogen molecules from forcing their way out through the outer wall of the beam 4.

[0033] Hydrogen can be stored in the chassis structure 3 under different temperatures and pressure. Preferably a storage temperature is used which is of the order of magnitude of room temperature and a storage pressure which, if permanently maintained, is preferably of the order of magnitude of about 40 bar. From this follows that, for example, beams and connections to the drive system of the vehicle 1, i.e. the fuel-consumption unit, must be configured and dimensioned with a view to this pressure level.

[0034] The principle which has been described above, in which a fuel-storage unit is formed by existing beams 4, 5, 6, 7 in a chassis structure 3, can also be used for storing other gaseous fuels, for example natural gas. In principle, the invention can be used for storing all types of gaseous or liquid fuels which are intended for engine-powered transport means. Expediently, however, gaseous fuels having a molecular size which is matched to the dimensions of the nanostructure in question, i.e. which allow optimal storage efficiency in the nanostructure, are used.

[0035] The basic principle behind the invention can also be used in such a way that transport means components other than beams forming part of a chassis structure can be used for such fuel storage. For example, exterior and inferior panel structures such as roof and floor panels, bonnet and boot lids, side panels and other body structures can be used for this purpose provided that they are configured in such a way that they are closed, i.e. with an inner, hollow storage space. Figure 3 shows an embodiment with a vehicle 1', which is constructed in the same manner, in principle, as the vehicle shown in Figure 1, i.e. having an outer body 2' and a chassis structure 3', which, in turn, is made up of a number of closed construction elements, more precisely comprising two longitudinal side beams 4', 5'. Between these side beams 4', 5' (which can be connected by means of transverse beams or like structures (not shown)), there is additionally arranged a structure in the form of a floor panel 11.

[0036] Figure 4 shows a somewhat enlarged view of a portion of the floor panel 11, which portion is indicated by a dashed circle having the reference notation B in Figure 3. As can be seen from Figure 4, the floor panel 11, in turn, is constructed in a manner corresponding in principle to the beams described with reference to Figures 1 and 2, i.e. the floor panel 11 is configured as a closed structure having an inner space in which a nanostructure 8' is arranged. As described above, this inner space is used as storage space for a fuel which is intended for the engine of the vehicle 1.

[0037] Analogous with what has been described with reference to Figures 1 and 2, the floor panel 11 according to Figure 4 is further provided with a barrier layer 9', which is disposed between the nanostructure 8' and a surrounding casing 10' belonging to the floor panel 11.

[0038] By using, for example, the beam structure of the vehicle 1 or a floor panel as an outer casing for a fuel-storage unit, very large quantities of hydrogen gas can be stored, i.e. without any special, separate hydrogen tank needing to be accommodated in the vehicle 1.

This will of course produce a very economical storage of hydrogen. When the invention is used in a normal passenger car, there is normally a combined cubic capacity of the beam elements, which can be used to store hydrogen, of the order of magnitude of 50-70 litres. In a structure in which both a nanostructure 8 and the said sealing layer 9 are used, a great range of travel for the vehicle, at least 20 000 km, is then obtained. In such cases, refilling of the hydrogen gas store can expediently be carried out during an ordinary vehicle service, which normally occurs at a 15 000 or 20 000 km interval.

[0039] When the invention is used for fuel storage in a vehicle of the passenger car type, it can be noted that there is in principle such a large accessible volume in a normal vehicle structure - provided that both the chassis structure and accessible panels, doors, floor, etc. are used - that the vehicle would never need to be refilled with hydrogen gas during the whole of its service life.

[0040] The invention is not limited to the above-described embodiment, but can be varied within the scope of the claims to follow. For example, the invention is not limited to be used for the storage of hydrogen gas, but can also be used for other gaseous fuels such as, for example, natural gas.

[0041] The invention can be used with different types of transport means, for example cars, boats, aeroplanes and space craft.

[0042] Furthermore, the above-described nanostructure can also, in principle, be excluded. However, this will not then allow the very high level of storage efficiency which has been described above. In principle, moreover, the abovementioned barrier layer can also be excluded, which might be of interest in those cases where a complete sealing can be obtained in the fuel storage unit itself. When hydrogen is used as fuel, the barrier layer is preferably used, however, in order to avoid the risk of hydrogen diffusing through the outer casing of the structure in question.

Claims

1. Device for storing fuel in an engine-powered transport means (1; 1'), comprising at least one closed construction element (4, 5, 6, 7; 11) which is incorporated as an integral part of the body or chassis structure (3; 3') of the transport means (1; 1'), characterized in that the said closed construction element (4, 5, 6, 7; 11), moreover, is arranged as a storage unit for the said fuel.

2. Device according to claim 1, characterized in that the said construction element (4, 5, 6, 7) comprises a beam element (4, 5, 6, 7) forming part of a chassis structure (3) in the transport means (1).

3. Device according to claims 1 or 2, characterized in that the said construction element comprises a panel, door, hatch or a floor structure (11) of the said transport means (1').

4. Device according to any of the preceding claims, characterized in that the said construction element (4, 5, 6, 7; 11) is configured so that its interior supports a nanostructure for storing the said fuel.

5. Device according to claim 5, characterized in that the fuel is hydrogen gas adsorbed in the said nanostructure.

6. Device according to any of the preceding claims, characterized in that the said construction element (4, 5, 6, 7; 11), within its shell surface, supports a barrier layer (9, 9') arranged to prevent fuel from leaking through the casing of the said construction element (4, 5, 6, 7; 11).

7. Device according to claim 6, characterized in that the said barrier layer (9;9') comprises a metal hydride compound.

8. Transport means (1; 1') comprising a fuel-storing device according to any of the preceding claims.

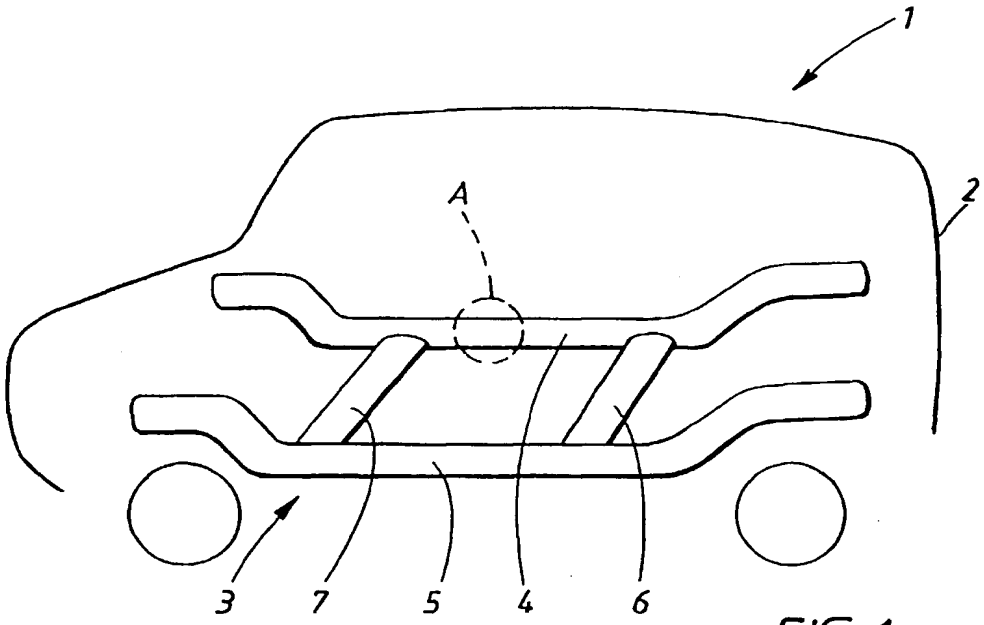

FIG. 1

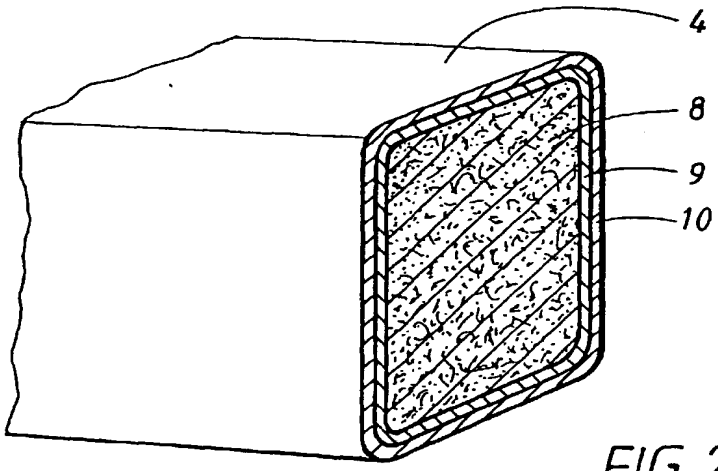

FIG. 2

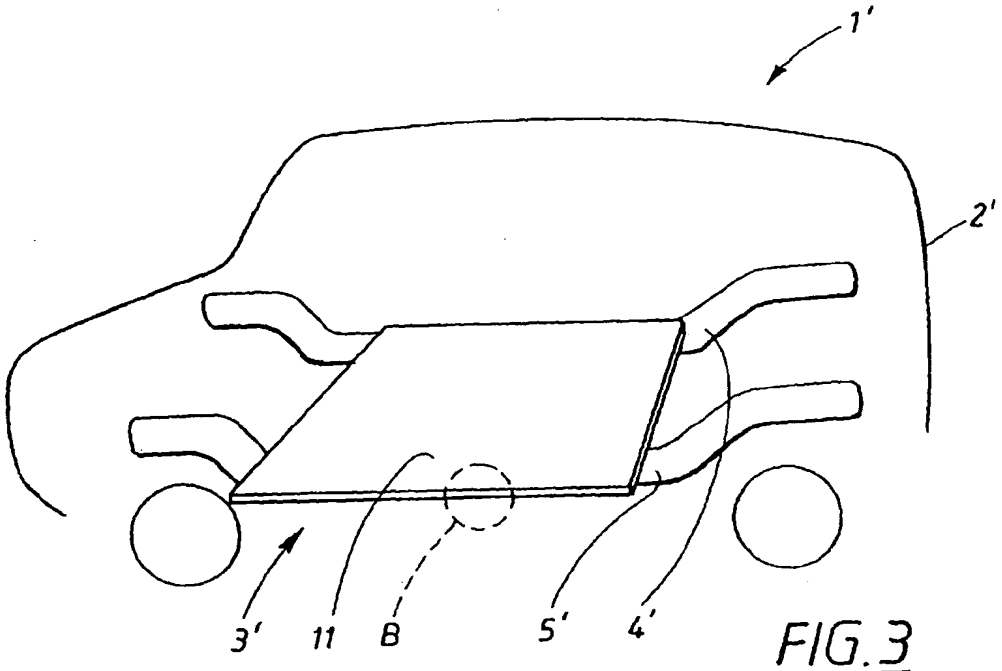

FIG.3

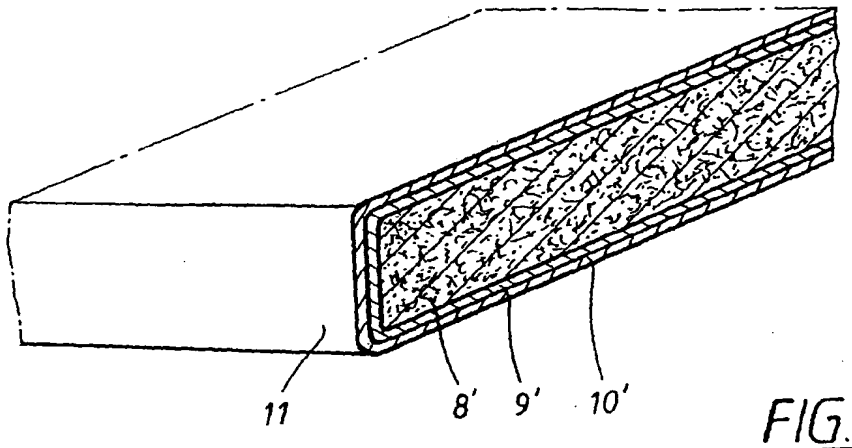

FIG.4

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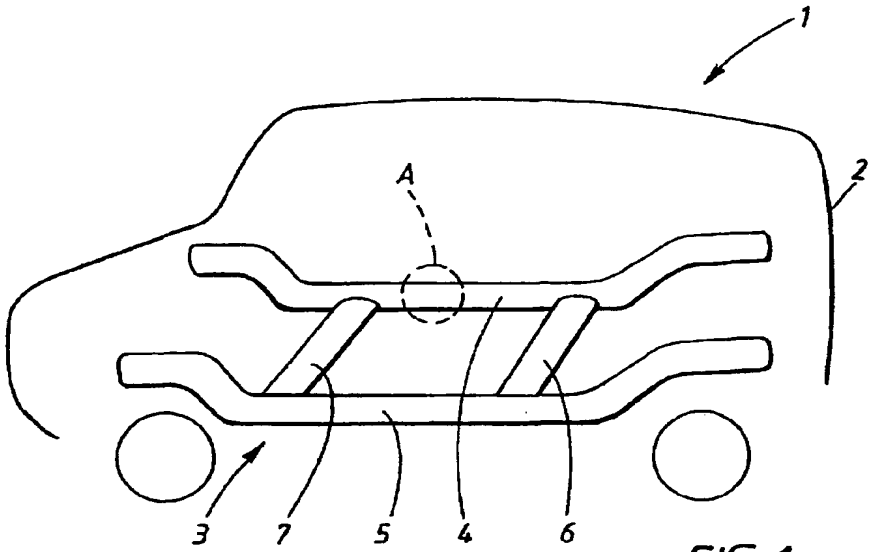

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	FR 2 742 403 A (SBARRO FRANSCECO) 20 June 1997 (1997-06-20) * page 4, paragraph 1; figures *	1,2,8	B62D21/16
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X	FR 965 800 A (CHABAY) 21 September 1950 (1950-09-21) * page 3, left-hand column, line 43 - line 50; claim 1; figures 7-9 *	1,2,8	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
B62D
B60K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 April 2003	Hageman, L

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D'avance merci

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